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ASSESSING THE FEASIBILITY OF USING CONTINGENCY MANAGEMENT TO MODIFY CIGARETTE SMOKING BY ADOLESCENTS

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Cigarette smoking is a leading cause of preventable death in the United States. Many smokers initiate this dangerous behavior during adolescence. This report describes a contingency management intervention designed to initate and maintain a period of abstinence from cigarettes by adolescent smokers. Results suggest that the intervention was generally successful and that further investigation of this topic is warranted.

DESCRIPTORS: adolescents, contingency management, cigarette smoking

Many current cigarette smokers used tobacco for the first time prior to reaching 18 years of age (Centers for Disease Control, 1998). Compared to nonsmokers, current adolescent smokers are significantly more likely to report use of illicit drugs, polysubstance abuse, current alcohol use, and episodic binge drinking (Everett, Giovino, Warren, Crossett, & Kann, 1998). Estimates indicate that two thirds of all adolescents have smoked one cigarette by the age of 18, 15% smoke every day, and 11% of high school seniors smoke at least 10 cigarettes per day (Johnston, O'Malley, & Bachman, 1998; Stanton, Lowe, & Gillespie, 1996). Among adolescents who are current smokers, 64% wanted to stop smoking and 55% had tried to stop in the past year (Stanton et al.). Smoking rates have declined among high school students over the past few years, but these rates remain uncomfortably high (i.e., 58% report lifetime smoking, 27% report current smoking, and 10% report current frequent cigarette smoking; Centers for Disease Control, 2004). Treatments for this dangerous behavior are urgently needed (e.g., Balch et al., 2004; Henningfield, Michaelides, & Sussman, 2000; Prokhorov, Hudmon, & Stancic, 2003; Sussman, Lichtman, Ritt, & Pallonen, 1999).

Unfortunately, methods such as nicotine replacement, which are useful in assisting adults to stop smoking, may not be well suited for use with adolescents (e.g., Henningfield et al., 2000; Hurt et al., 2000; Prokhorov et al., 2003). One method that may be useful in modifying this perilous behavior is contingency management, a scientifically based behavior modification technique that has been successful at initiating abstinence from a variety of drugs of abuse among adult drug users (e.g., Higgins & Silverman, 1999; Petry, 2000). The use of this technique among adolescent substance users has been less thoroughly researched (see Roll & Watson, in press, for a review). Our group conducted a pilot study with adolescent cigarette smokers that suggested that contingency management might be effective in helping adolescents terminate smoking (Corby, Roll, Ledgerwood, & Schuster, 2000). As a follow-up to that initial experiment, the current report describes a small-scale study designed to further assess the utility of using contingency management in the treatment of adolescent cigarette smoking.

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Early results from the study were presented at the College on Problems of Drug Dependence and the Association for Behavior Analysis (Roll & Watson, in press).

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Participants and Settings

This report presents data from 22 adolescent cigarette smokers who reported a desire to quit smoking and who participated during the 1st week of a 4-week intervention. Thirty-one individuals started the baseline interviews, but 10 did not begin the intervention and were not included in this analysis because they did not participate in the contingency management phase of the trial. Participants were randomly assigned to one of two conditions: abstinence (n = 12) or attendance (n = 10) (described below). All participants, regardless of group assignment, provided two baseline carbon monoxide (CO) samples on the two Fridays preceding the 4-week contingency management phase of the trial. During these 2 weeks, participants were instructed to smoke in their normal fashion. CO samples were obtained by having participants blow through a small handheld device that provided immediate feedback (Bedfont). This is a commonly used technique for measuring recent cigarette smoking (Society for Research on Nicotine and Tobacco Subcommittee on Biochemical Verification, 2002). Although it is true that this technique does not guarantee detection of all cigarette smoking, it is still a well-accepted means for detecting recent cigarette smoking, and it correlates strongly with cigarette smoking (Deveci, Deveci, & Ozan, 2004). During a 4-week intervention phase, participants in both groups received educational material about the dangers associated with smoking and were told to use their ''willpower'' to quit smoking. Participants were instructed to use their willpower because this is what participants in other contingency management interventions have attributed their ability to abstain from drugs to (e.g., Silverman et al., 1998). All participants provided a daily breath sample for CO analysis at approximately the same time each day. In addition, participants responded on 4-point scales that measured ''desire to smoke'' and ''physical need to smoke.'' Participants also received any vouchers they had earned (see below) during this brief (5- to 10-min) session. Participants were contacted for a follow-up visit 1 month after the intervention ended, and were asked to provide a CO sample for which they were given a $10 voucher, regardless of the CO level.

Thirty-eight percent of the group was female, and 62% was male. The mean age was 16.5 years. Fifteen were Caucasian, 4 were Hispanic, 2 were African American, and 1 was Asian American. All participants were daily smokers, reported a desire to quit smoking and having tried to quit, on average, twice. Participants had been smoking, on average, for 4 years. The study was conducted at a research laboratory and clinic located in southern California. All participants provided assent and their legal guardians provided consent for participation.

Group Description

Abstinence group. Participants in this group earned vouchers, redeemable at a local department store, worth $5 every time they provided a CO sample that met our criterion for recent abstinence from cigarettes (<6 ppm). In addition, if they were abstinent all week, they received a bonus voucher which was worth $10 the 1st week, $20 the 2nd, $30 the 3rd, and $40 the 4th. Failure to abstain all week resulted in a reset of the amount of the next available bonus voucher to $10. This schedule of voucher disbursement incorporates those components shown in prior studies to be effective in promoting and maintaining abstinence (e.g., Roll & Higgins, 2000; Roll, Higgins, & Badger, 1996; Roll et al., in press).

Attendance group. This group was identical to the abstinence group except that participants in this group earned vouchers worth $5 every time they attended a scheduled session and provided a CO sample, regardless of what the CO sample was. In addition, if they attended all sessions in a given week, they received a bonus voucher that was worth $10 the 1st week, $20 the 2nd, $30 the 3rd, and

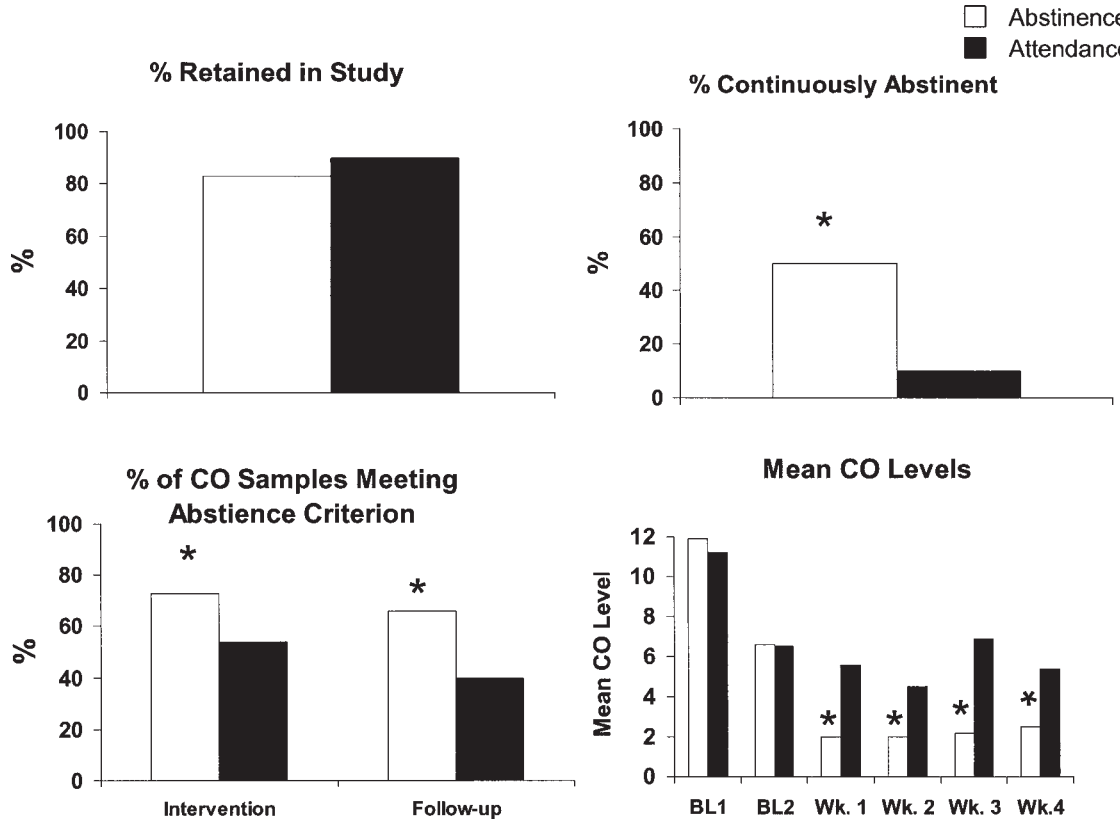

Figure 1. Total percentage of participants who completed the 4-week intervention (upper left), percentage of participants who provided CO samples of <6 ppm for the entire 4-week intervention (upper right), percentage of CO samples <6 ppm provided during the 4-week intervention and at the 1-month follow-up (lower left), and mean CO levels during baseline and intervention weeks (lower right). * $p < .05$.

$40 the 4th. Failure to attend all weekly sessions resulted in a reset of the amount of the bonus voucher to $10.

It is important to note that participants in both groups could earn exactly the same amount of vouchers. The only difference was that the vouchers were contingent on abstinence (i.e., CO <6 ppm) or attendance.

RESULTS

There were no between-group differences in retention with 83% of the abstinence group and 90% of the attendance group completing the entire intervention (Fisher's exact test, $p > .05$) (Figure 1). More participants in the attendance group presented for a 1-month postintervention follow-up visit (abstinence group = 66%, attendance group = 80%, Fisher's exact test, $p < .05$). The percentage of participants who remained continuously abstinent throughout the 4-week intervention differed significantly between groups (abstinence group = 50%, attendance group = 10%, Fisher's exact test, $p < .05$) (Figure 1). The percentage of CO samples that met the abstinence criterion differed across groups during the 4-week intervention (abstinence group = 73%, attendance group = 54%, Fisher's exact test, $p < .05$) and at the 1-month postintervention follow-up (abstinence group = 66%, attendance group = 40%, Fisher's exact test, $p < .05$). For these analyses, missing samples were considered positive.

Overall mean CO levels differed between conditions ($t = 2.346$, $df = 5$, $p < .05$). Post hoc comparisons and visual inspection reveal that these differences all occurred during the intervention phase and not in the baseline phase (Figure 1). The percentage of group members who obtained a continuous week of abstinence at any point during the intervention was high for both groups (abstinence group = 83%, attendance group = 86%); however, the percentage of participants who relapsed (i.e., who provided a CO sample >5 ppm) following that week of abstinence was significantly lower in the abstinence group (12%) than in the attendance group (50%) (Fisher's exact test = .303, $p < .05$). Finally, participants in the abstinence group reported less desire to smoke ($M = 2 \pm 0.001$ on a 4-point scale) than did participants in the attendance group ($M = 1.7 \pm 0.08$; $t = 2.05$, $df = 19$, $p < .05$). Similarly, participants in the abstinence group reported a greater physical need to smoke ($M = 1.7 \pm 0.03$) than did participants in the attendance group ($M = 1 \pm 0.05$; $t = 10.323$, $df = 19$, $p < .05$).

DISCUSSION

These results suggest that contingency management can reduce smoking among adolescents. Both groups reduced their smoking from baseline levels, presumably due to the structured focus on their smoking, the educational material concerning the dangers associated with smoking, and the frequent CO monitoring. However, those in the group who received vouchers contingent on abstinence were able to decrease their smoking more than those who received vouchers contingent on attendance. This decrease was reflected in several dependent measures, including (a) more continuous abstinence, (b) the percentage of CO samples that met the abstinence criterion during the intervention, and (c) lower mean CO levels during the intervention. In addition, those in the abstinence group were less likely to relapse during the intervention once they had obtained a clinically relevant period of abstinence (i.e., 1 week) than were those in the attendance group. This suggests that contingency management may be useful in maintaining abstinence once it is initiated. This is further supported in the follow-up data, in which a greater percentage of participants in the abstinence group provided a CO sample that met the criterion for abstinence.

The verbal behavior of the participants also provides support for the observation that participants in the abstinence group were smoking less than those in the attendance group. Participants in the abstinence group reported higher levels of craving and physical need for cigarettes than did those in the attendance group, possibly suggesting that those in the abstinence group were experiencing stronger withdrawal symptoms than those in the attendance group.

Limitations to this study are the small sample size and the relatively infrequent monitoring of cigarette smoking. The small sample size is justified because both retention rates and results are consistent across measures and the study is a pilot study. Carbon monoxide was measured daily because of practical concerns. It would be difficult to measure it more frequently in a group of active adolescents or to use a more invasive measurement strategy (e.g., urine, plasma, or saliva collection for other biochemical markers) in a cessation program that was both acceptable to adolescents and could be easily delivered in most community settings. Therefore, some measurement sensitivity was sacrificed to begin to gather field data about the use of the technique. Nevertheless, the measurement time frame used in this study permits the possibility of surreptitious smoking (e.g., smoking immediately after one day's CO measurement would not likely be detected on the next day's measurement). However, the combined measures of abstinence both during treatment and at follow-up, as well as the verbal

reports that showed greater withdrawal symptoms in those in the abstinence group, suggest that the intervention was effective in modifying the smoking behavior of this group of adolescents. In support of this strategy, others have reported using infrequent CO monitoring for practical reasons (e.g., Shoptaw et al., 2002).

Although the current findings suggest that contingency management may provide a potentially effective treatment for adolescent cigarette smoking, the current findings should be viewed as preliminary, given the above limitations. Future studies are needed to refine the methods and rule out the possibility of undetected cigarette smoking in the abstinence group.

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